Democracy Dies in Darkness

Brain scans reveal 3 ADHD subtypes, including a more extreme form

Researchers identified a more severe presentation of the condition marked by emotional dysregulation.

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By Ariana Eunjung Cha

The classic image of a child with ADHD is practically a stock character: the spacey kid staring out the window, distracted by squirrels; the fidgeter who can't sit still, a leg rattling under the desk.

But parents and teachers also describe a more extreme type that stumps them: kids who erupt, collapsing onto the floor — screaming, crying, sometimes throwing or breaking things when overwhelmed.

Think Veruca Salt, the rich girl from "Willy Wonka & the Chocolate Factory," who demands everything now, or Angelica Pickles from "Rugrats," whose emotions flip without warning — but turned up several notches.

Some physicians and researchers have argued for years that emotional dysregulation is not peripheral to ADHD but a central, overlooked part of the condition. Yet this symptom does not appear in the formal diagnostic criteria for ADHD in the manual that doctors use to classify mental disorders. That gap has left clinicians without a clear way to categorize what they're seeing: Are these children best understood as having severe anxiety, as being on the autism spectrum, or as something else entirely? Or does ADHD itself need to be more broadly defined?

A study published in JAMA Psychiatry this year analyzing 1,154 brain scans of children and adolescents offers fresh evidence for reevaluating the medical establishment's definition of the disorder.

The researchers grouped three forms of ADHD identified in the imaging into familiar — and one less familiar — categories: predominantly inattentive; predominantly hyperactive/impulsive; and a more severe, combined presentation marked by emotional dysregulation or difficulty managing and responding to emotions in a controlled, appropriate way.

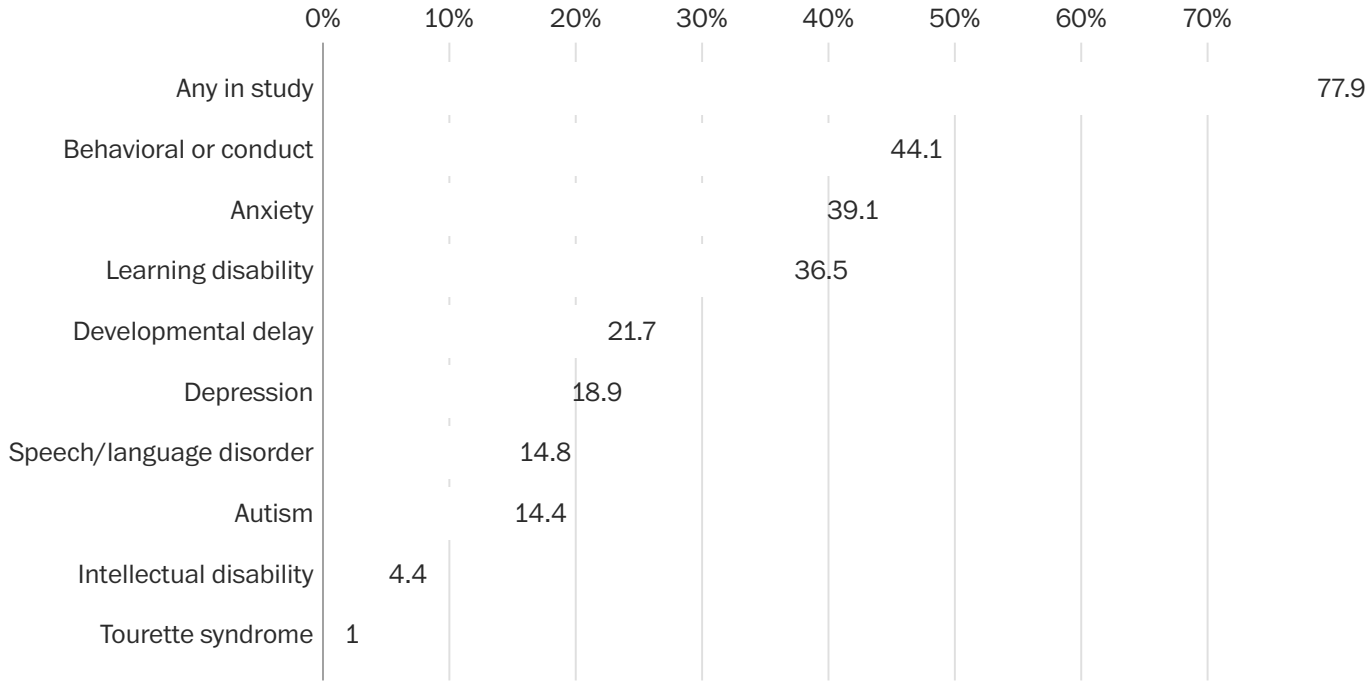
> This idea has been around for maybe 20 years but it's becoming more and more creditable.
>
> — F. Xavier Castellanos, a neuroscientist at New York University

The findings are part of a broader shift: Advances in brain imaging are pushing scientists beyond symptom-based labels toward biologically grounded classifications of neurological conditions — an approach already reshaping autism research, where a study published last year identified four distinct subtypes.

ADHD is one of the most commonly diagnosed neurodevelopmental conditions, affecting roughly 1 in 9 U.S. children — about 11 percent — according to the latest data from the Centers for Disease Control and Prevention, a prevalence that is reshaping classrooms and placing growing demands on schools, clinicians, and families to provide adequate support and resources. Yet treating it remains complex: While effective medications exist, the condition often overlaps with other disorders and presents in diverse ways, complicating diagnosis and care.

Overlapping diagnoses

More than three-fourths of children with ADHD had at least one other co-occurring condition, according to a national 2022 parent survey.



Source: Centers for Disease Control and Prevention

In the new study, the first two categories map neatly onto the way ADHD is currently diagnosed, dividing along a well-established line between difficulties with focus and problems with hyperactivity and impulse control.

The third, however, pushes the field into new territory.

This extreme subtype exhibited the most extensive changes across the brain — a total of 45 abnormal areas versus 26 each for the other two subgroups.

Brain imaging suggests this subtype is not just "more" ADHD — with a higher degree of changes — but something meaningfully different. According to lead researcher Nanfang Pan, there was "extensive disruption" across two areas tied to emotion and control: the medial prefrontal cortex and pallidum. This points to a distinct pattern, not simply a greater degree of the same disruption. Differences in the prefrontal cortex may help explain mood swings. Changes in the pallidum, which helps regulate emotional responses and motivation, may help explain the intensity and volatility of those reactions.

"I was surprised by how cleanly our results came together," said Pan, a neuroimaging expert with the West China Hospital of Sichuan University and the Turner Institute for Brain and Mental Health at Monash University in Australia. "We used no clinical information whatsoever in the clustering, and yet the three biotypes that emerged mapped well onto clinically recognized ADHD presentations."

'Simmering volcanoes'

Emotional dysregulation in children has long been a difficult area for clinicians to pin down — common, consequential and yet ill-defined.

"There's really no diagnosis specific to dysregulation," says Paul Rosen, director of the ADHD Rapid Assessment Clinic in the Division of Behavioral and Mental Health with Norton Children's Medical Group in Louisville.

There are related labels — disruptive mood dysregulation disorder (DMDD), oppositional defiant disorder (ODD), unspecified mood disorders — but clinicians often hesitate to use them. The terms can feel blunt, even stigmatizing, and don't always capture what they are seeing.

ADHD itself is typically diagnosed through parent and teacher reports, using standardized behavioral questionnaires. But when emotional reactivity is part of the picture, things can become harder to interpret.

A 2014 paper described two patterns of more severe dysregulation among children with ADHD. One group was labeled "irritable," though Rosen describes them differently.

"I refer to them as super bouncy ball kids," Rosen said. "Everything is great until it isn't, and then 5 minutes later, it's like nothing happened. Whatever they are feeling, they are feeling a lot of it."

The second group presents a different challenge. These children tend to be more persistently volatile.

"They are simmering volcanoes basically," Rosen said. "When things go wrong, they explode. These are kids who will have hour-long meltdowns, throw things and hit and break things."

This group, Rosen said, appears to align with the new "extreme" ADHD type in the new study. These children often require more intensive treatment and intervention. Many have additional diagnoses beyond ADHD, including anxiety and depression, and are frequently prescribed multiple medications.

Melissa DelBello, a professor of psychiatry and pediatrics at the University of Cincinnati, said that while brain imaging holds promise, it is still impractical to conduct such scans broadly in clinical settings because they are too expensive and not yet precise enough at the level of the individual. Still, she sees studies like this as a step toward something more tailored.

A path for treatments?

For children with this extreme form of ADHD, standard behavioral strategies may fall short. DelBello said that widely used approaches such as positive reinforcement — like giving prizes or other trinkets, or extra recess for good behavior — do not always have the intended effect.

"They are not as sensitive to rewards," DelBello said.

They may also be among those for whom stimulant medications — the first-line treatment for ADHD — do not always work, though it remains unclear how best to categorize them.

Identifying "specific subtypes" of ADHD will make it easier to treat these children effectively, DelBello said.

F. Xavier Castellanos, a neuroscientist at New York University who has spent decades studying ADHD brain networks, was part of the working group for the DSM-5, the latest diagnostic manual for psychiatric conditions that was first released in 2013 and updated in 2022. At the time, he said, there was pressure to be cautious; the science was not yet strong enough to support major changes to redefine ADHD.

Now, he said, that may be shifting, and for the next version, he said he would be surprised if an emotional dysregulation subtype was not included.

"This idea has been around for maybe 20 years, but it's becoming more and more credible. And the science is at a point that it looks like we are up to something real," Castellanos said.

What readers are saying

The comments reflect a wide range of perspectives on ADHD, with many expressing personal experiences and challenges related to the condition. Some commenters emphasize the complexity of diagnosing ADHD, noting overlaps with other conditions like anxiety and sensory processing... Show more

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